







#### 4. Electoral Systems Practiced in Advanced Countries

This section reviews global current best practice electoral systems as practiced in some developed countries, which are often more democratic and modernized than what is obtainable in developing countries. A framework for making a comparison between the advanced and developing continents with respect to the electoral systems currently practiced is stimulated. The comparison facilitates a structure for identifying key physical tools and constructs essential for implementing an integrated electoral (online) system. Electoral systems are described as a set of procedures, which regulates how referendums and elections are conducted and how the results are established. This may be either a political electoral system associated with government institutions or non-political electoral systems organized by business entities or informal sectors. Electoral systems significantly influences who participates, loses and wins an election ultimately forming a government (Reynolds, et al., 2005). The electoral system is, therefore, a critical factor in implementing democratic principles in any given context. The foremost types of electoral system practiced across the globe as adapted from (Reynolds, et al., 2005 and Norris, 1997) is presented in Figure 3.

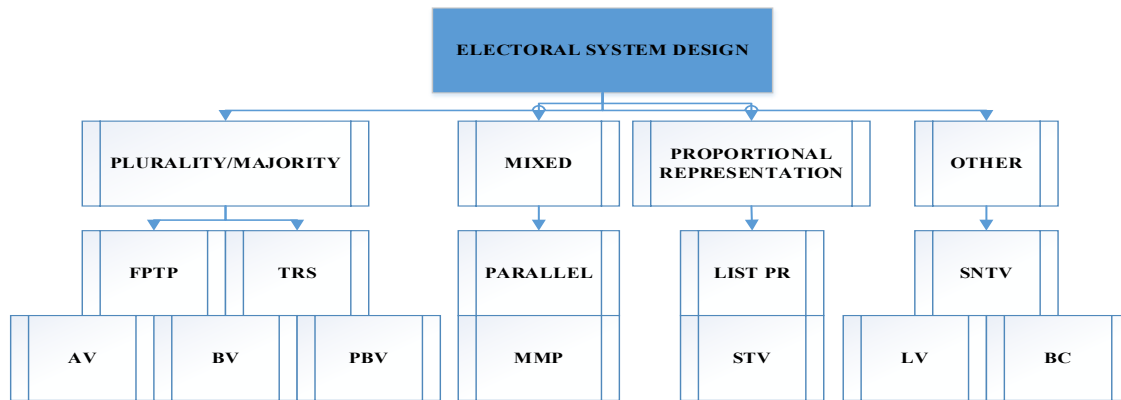


Figure 3. Electoral system design adapted from (Reynolds, et al., 2005 and Norris, 1997)

A synopsis of each fundamental electoral system presented in Figure 3 is detailed.

##### Plurality/Majority electoral system

A plurality electoral system is the most common method and operates optimally in a two-party system structure. Plurality describes an electoral process in which an aspirant seeking election who polls more votes than other contenders is elected despite not gathering majority (Vowles, 2010). This electoral system is distinguished from the majority electoral system in which the aspirants must gather more votes (above 50%) than all other candidates combined. Both electoral systems are comparable as the methods elect aspirants with most votes. The plurality/majority electoral system is as practiced in the United States of America (USA), Malaysia, France and the United Kingdom (UK). Some approaches of the plurality/majoritarian electoral systems are the First-Past-the-Post (FPTP), Two-Round System (TRS), Alternative Vote (AV), Block vote (BV) and Party Block Vote (PBV). An exploratory of each approach is presented in (Reynolds, et al., 2005).

##### Mixed electoral system

The mixed electoral system combines the plurality/majority and proportional electoral system describing an electoral structure in which electorates are provided two votes for legislation with an element of proportional representation (Manow, 2011). One of the votes decides legislatures for a single-seat constituency while the other vote is for political party affiliation as practiced in Romania 2008 and 2012 elections. The mixed electoral system balances the disadvantages and advantages of both the plurality/majority and proportional electoral system. The mixed electoral system is as practiced in Germany, Japan, South Korea, Russia, Azerbaijan, Bolivia, Georgia, and New Zealand. Some approaches of the mixed electoral system are the Parallel Mixed Member Majoritarian (MMM) and Mixed Member Proportional (MMP).

##### Proportional representation electoral system

Proportional representation electoral system reflects a voting structure in which divisions or political parties into elective positions is determined by the number of popular votes gathered. The proportionality representation electoral system is as practiced in countries like Belgium, Finland, Denmark, Switzerland, Spain, Sweden, Greece, Israel,

Hungary, Norway, Italy, Luxembourg, Austria, Northern Ireland, and Russia. Some approaches of the proportional representation electoral systems are the list Proportional Representation (PR) and Single Transferable Vote (STV).

### **Others**

Certain electoral systems are adopted in multi-member districts. Some of the approaches include Single Non-Transferable Vote (SNTV) where each electorate casts one vote for an aspirant but unlike the FPTP approach, more than one seat is occupied in each electoral district and Limited Vote (LV) where the electorates have more than there are aspirants to be elected.

Any of the various forms of electoral systems is considered based on the various countries necessity in a specific context. The highpoints of each electoral system are the adoption of physical systems such as mobile phones as an authentication tool. The use of mobile phones aligning with the 4IR implementations for the election process in developing countries presents challenges and opportunities (Baguma & Eilu, 2015). Enhancing real-time authentication access via mobile phones based on 4IR implementations is essential. Mobile phones present ease of access for eligible electorates both onsite and in diaspora (off-site) to participate in an electoral process. The next section identifies and highlights five key constructs essential for implementing an integrated electoral (online) system via physical systems inclusive of mobile phones.

## **5. Key 4IR Constructs for Enhancing the Electoral System**

The biometric system is a dynamic technological imperative on fundamental 4IR implementation constructs. This section identifies and explores five key constructs essential for enhancing the electoral process in Nigeria as a developing country in an African context. Five key constructs presented in Figure 4 which includes “capacity”, “ethics”, functionality”, “structure” and “data storage” are highlighted. The five key constructs are identified from a detailed technology review of the Massachusetts Institute of Technology (MIT) white papers publications.

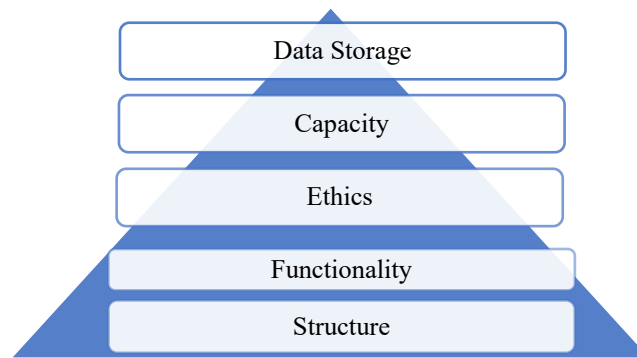


Figure 4. Key constructs of the electoral system

A synopsis of each key construct presented in Figure 4 aligning with proposed 4IR implementations is detailed.

### **Data storage**

The electoral system gathers and stores large volumes of data throughout the execution of the electoral process both on and off sites across several geographical locations. This research proposes for a structure resulting in a comprehensive, focused data set for collection, analysis, and storage. An automated cloud storage structure aligning with 4IR implementations is essential towards advancing the electoral process in Nigeria as a developing country. Cloud storage is a 4IR technology effective for providing data supporting proactive and predictive opportunities (Slamanig & Hanser, 2012). Cloud system presents a model of data storage in which digital data is gathered in servers and logical pools with the physical environment possessed and managed by a hosting platform (Hart, et al., 2016). Rather than single data points at short intervals, the cloud storage system promotes the continuous stream of high-value data. A framework for managing high-volumes and magnitude of data is supported aligning with the 4IR implementations. Cloud storage system facilitates a structure for easy access to data for census, developing a social system of individuals and gathering opinion polls on national issues inclusive of economic, social, electoral, security and political concerns. Attributes of the cloud storage system relative to the electoral process adapted from (Roblek, et al., 2016) includes but not limited to:

- (i) Scanning, capturing and storage of an analog/digital image of individual personal characteristics.
- (ii) Compression, comparison and processing of an individual's image to a cloud database structure of stored images.
- (iii) Interface with application structures.
- (iv) Supports a structure for predictive analytics.

Benchmarks to be considered prior to developing an automated cloud storage structure as adapted from a publication accessible from the data protection ethics library on ethical issues in data management is detailed. These benchmarks enhance the success rate in developing and effecting an automated cloud storage structure.

- (i) Anticipate how the data gathered will be utilised.
- (ii) Develop and study the use case.
- (iii) Retain raw data as raw.
- (iv) Store collected data in open formats.
- (v) Data ought to be structured for ease of analysis.
- (vi) Data ought to be uniquely identifiable.
- (vii) Link essential metadata.
- (viii) Adopt efficient privacy protocols.
- (ix) Develop a systematic backup structure.
- (x) The location and approach of data storage are dependent on the quantity of data to be generated.

### **Capacity**

Capacity describes the ability of the physical systems deployed for the electoral process to possess certain benchmark features. This research proposes for the authentication process of an electoral system to be integrated with the facial recognition feature. The effectiveness of facial recognition feature for authenticating, unlocking or granting access to a system is demonstrated in numerous applications. This is detailed in a (2009) publication from emerging trends in information technology. Facial recognition is a 4IR technology operationalised based on a structured light scheme deploying suites of sensors for capturing visage in three dimensions (3-D). The sensors activate an infrared light, which illuminates the face and stimulates a projector projecting an array of infrared dots. The infrared camera captures the infrared dots, which the electoral physical systems employ in authenticating an individual against a previously stored image of the individuals face in the automated cloud storage device. The facial recognition feature limits trepidations associated with electoral authentication and security (spoofing). There is one in a million chance an individual can spoof an already captured image in the automated cloud database. Aside from requiring a measure of the individuals' attention for authentication, it is configured with a realistic looking 3-D mask which is efficient in preventing spoofing. Benchmarks to be considered exploring capacity as a key construct related to the electoral process includes but not limited to:

- (i) **Time:** The time between enrollment and authentication of an individual image.
- (ii) **Position/Light conditions:** Visibility of occluding items such as glasses, hat, scarf, beards.
- (iii) **Retina scanning:** Utilizes the unique patterns on individual retina blood vessels.
- (iv) **Iris scanning:** Utilizes mathematical unique pattern recognition methods or near-infrared illumination on video images of an individual's eyes of both or one the irises.

The facial recognition capacity means an individual's face effectively serves as a barcode to authenticate and access an electoral system.

### **Functionality**

The physical systems deployed for an electoral process are only efficient when electoral stakeholders are able to translate the capacity insights developed into functional programs delivering optimal returns. Functionality is the articulation of the benchmark conditions the electoral process requires to deliver and perform optimally. The government, public and private institutions prior to an electoral process ought to define the type of electoral system to be practiced. Functionality also includes ease of access for eligible electorates both onsite and in diaspora (off-site) to participate in an electoral process. Benchmarks to be considered exploring functionality as a key construct related to the electoral process includes but not limited to:

- (i) Guidelines of the electoral system to be practiced between plurality/majority, mixed, proportional representation or others.

- (ii) The time frame of the electoral process which includes planning, education, registration, training, and execution.
- (iii) Easy accessibility of electorates participating in voting both onsite and in the diaspora.
- (iv) Nomination, campaign, marking, authentication, casting and counting of ballots.

Data analytics and exchange is a 4IR implementation and can be employed in operationalising the benchmark conditions of functionality defined as a key construct related to the electoral process.

### **Ethics**

The ethical principles governing each electoral structure is a key construct towards ensuring optimal execution and delivery of an election process. Ethics seeks for the availability of data protection rights that apply inclusive of safety and protection of an individual's information. Ethical principles aligning with the 4IR implementations is extensively discussed in literature (Kassner, 2017 and Timothy, 2017). Benchmarks to be considered exploring ethics as a key construct related to the electoral process includes but not limited to:

- (i) **Beneficial:** This seeks to measure if the data usage benefits both the electorate and stakeholders. The electoral stakeholders ought to constantly define the expectations associated with data storage and usage promoting a framework for effective evaluation.
- (ii) **Progressive:** Are there defined philosophies for data minimization and continuous improvements. If the projected enhancements can be accomplished in a less data-intensive method, then less-intensive processing is pursued. This promotes a sustainable and minimal risk analysis eliminating the disenfranchising of electorates.
- (iii) **Sustainable:** Are the insights identified with the collected data sustainable over time. Sustainability enablers include data sustainability, device/manufacturer based sustainability, algorithmic sustainability.
- (iv) **Respectful:** This measures if the stakeholders have been inclusive and transparent with the electorates. This includes the capturing, aggregation and regulation of data.
- (v) **Fair:** This seeks to measure the potential impacts of captured data and usage on all electorates and stakeholders in the electoral process. Are there policies prohibiting discrimination relative to genetics, race, and gender.

This research suggests applying a pragmatic approach of the five ethical principles detailed in incorporating ethics into the electoral system.

### **Structure**

Structure as a key construct relative to the electoral process seeks for an electoral model effective for wrangling, assembling and contextualizing data from multiple sources both offline and online. Configuring an operations-wide integrated and centralized electoral structure based on defined key constructs is effective for generating an overarching assessment of the effects and benefits of 4IR implementations relative to enhancing the electoral process. This ensures the comprehensive capturing, analysis and storage of a precise set of data. This key construct also seeks for the efficient assembly of an efficient management team with comprehensive knowledge on the execution of defined key constructs. If an efficient management team implements the appropriate electoral key constructs, positive electoral outcomes abound.

Synchronizing these key constructs on physical systems deployed for the electoral process is remarkable resulting in an easier structure for electorates to be involved in the electoral process across several locations connecting to a singular database. A structure for capturing a comprehensive, focused data set for analysis is supported. This research proposes physical systems that can be leveraged by migrants to effectively engage in the electoral process with their respective homelands. Developing an integrated electoral process based on key constructs discussed combining both the physical and behavioural biometric technology real-time authentication results to ease of access for electorates in the diaspora to effectively and securely participate in the electoral process, exercising civic rights and responsibilities.

## **6. System of systems**

The indication of the system of systems is to develop an integrated electoral structure segregated into sub-systems representing key electoral constructs extensively detailed. The system of systems is developed based on 4IR biometric technology implementations. The sub-systems are configured with data set from each sub-system effectively communicating with another sub-system. This results in a framework for viewing the electoral structure holistically, which serves as an integrated decision-support paradigm for conducting and executing electoral decisions. This research facilitates for the development of a smart electoral structure in developing countries based on the integration of 4IR key constructs defined with modernized electoral systems as practiced in developed countries. Electoral

successes are evaluated among electorates on the indices of optimal participation in the electoral process. There is a necessity for the public, private and government institutions to develop and support an active structure enabling electorates fully participate in the process. An indication of the systems to systems framework is captured in Figure 5. The framework ought to be effective in allowing for migrants engagements in the electoral process, which can be achieved at various Nigeria consulates and high-commissions across the globe linked to a unified database. This is supported by the systems to systems framework, which allows for cloud storage and unified database obtainable from information sources such as driver’s license, international passport, Bank Verification Number (BVN) and examination enrolments of qualified electorates.

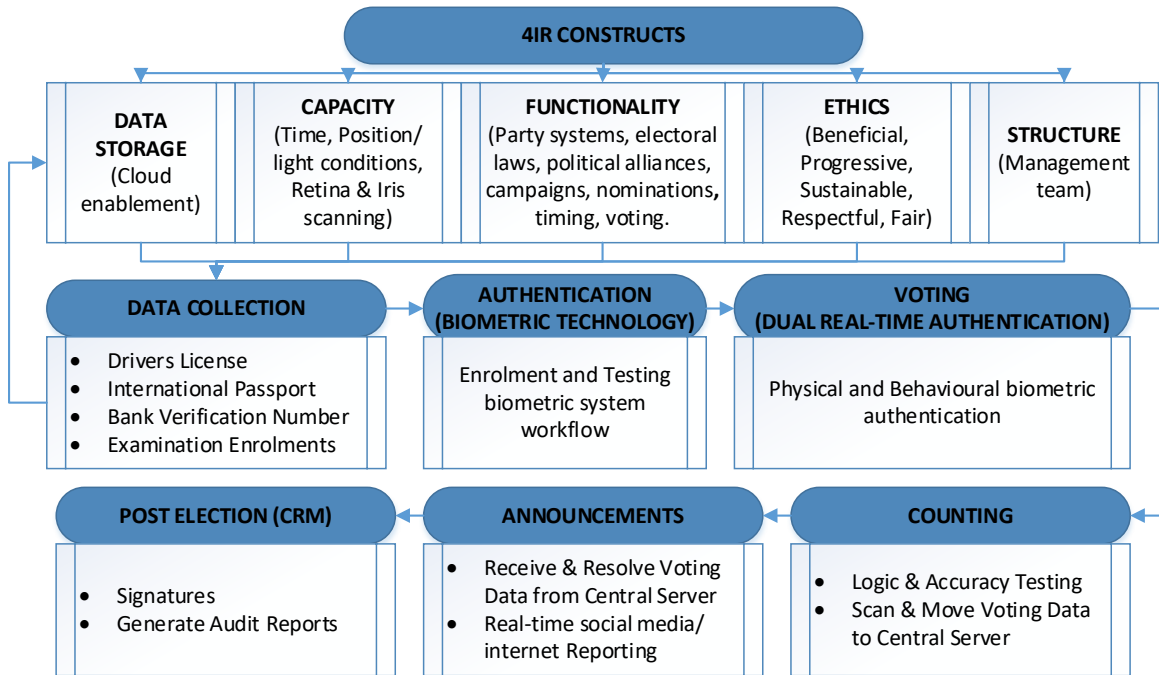


Figure 5. Systems to systems electoral framework

Driver’s license, international passport, BVN and examination enrolments as sources of data collection can develop a comprehensive and reliable database of electorates limiting continual waste of resources requiring physical migrants’ engagement for voters’ registration and participation in the electoral process. This research discussed the implications of the 4IR implementations premised on biometric technology and mobile physical systems in enhancing the electoral process. The various forms of electoral systems practiced in advanced countries are highlighted. The choice of electoral system and authentication process has significant implications on the implementations of an electoral process. This includes evolving political parties or party systems, electoral laws, choice of the political alliances, campaigns, electoral timings, nomination, and voting. To understand how the electoral process function and be implemented, it is essential to explore the nature of the electoral system and its relationship relative to political parties and conduct. This information presents better understanding and possibilities of alternatives together with disadvantages and advantages when prospects for electoral reform arises. This research proposed a fundamental shift from the way the election process is practiced in developing countries specifically Nigeria. This research leverages and explores essential 4IR key constructs relative to enhancing the electoral process. The use of mobile phones or devices as a physical system for real-time authentication based on 4IR key constructs of the biometric technology is emphasised. Presumably, the objective of any electoral stakeholder is a free, fair and fully participated electoral process enhancing electoral outcomes. The fundamental constructs based on the 4IR implementations specifically biometric technology limits security trepidations and real-time authentication process. Despite the advantages of the 4IR implementations specifically biometric technology, there exist certain limitations. Such as spoofing. Spoofing describes individuals impersonating as others to gain illegal access to protected or sensitive assets. Developing an integrated electoral process based on key constructs discussed combining both the physical and behavioural biometric technology real-time authentication process limits this limitation. There is one in a million chance an individual can spoof an already captured image in the automated cloud database. There have however been several published types of research developing and advising on anti-spoofing measures and solutions (Manow, 2011).



## **Conclusion**

There is essential for facilitating the evolution of the electoral process in developing countries towards 4IR implementations. An electoral structure developed on the basis of 4IR implementations enables electorate view the electoral process as a process and not an event. This limits manipulation, fraud, security anxieties, and violence. Exploring best practices relative to the measures electoral process dynamics is evaluated is critical in enhancing electoral reforms, democratic principles and realizing a genuine representation. This research focused on exploring the implications of the electoral system in Nigeria as a subset of the African context based on fourth industrial revolutions. 4IR implementations are the big unexploited current technological trends relative to the electoral structure. This research document is a significant tool for developing countries relative to electoral assessment and implementations. Electoral stakeholders must rethink and redevelop strategies to align the electoral process with the 4IR implementations. This research output seeks to mitigate the skepticism and mistrust experienced by electorates relative to the electoral process effectively representing democratic and civic interests.

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